



Remedial Process Optimization (RPO) Basics

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NJDEP and ITRC RPO Optimization Seminar



The Problem

- Numerous remedial action systems now in place
- Long time between ROD/Order and initiation of system operation
- Rapid technology development quickly outdates older designs
- Primary emphasis on capital costs. Limited initial emphasis on long-term (life cycle) operations and monitoring costs
- Long-term mortgages associated with operations and monitoring



The Problem (cont.)

- Decreasing funding for increasing number of active remediation systems.
- Initial design may not have enough emphasis on long-term operations/monitoring.
- Reliability, safety, compliance, and site funding inconsistencies.
- Aging sites with perpetual costs.
- Constantly changing site environmental and operating conditions... If system is working.



The Challenges

- Lower costs
- Reduce risk and uncertainty
- Ensure compliance
- Simplify operations
- Optimize performance
- Accelerate to closure



Various Working Definitions of Optimization

- Minimize costs – Capital versus life cycle costs
- Maximize performance – Rate vs. efficiency
- What you do when nothing else works (can't close)
- Minimize surprises – No weekend/night work
- Value engineering – Better, smarter, cheaper, etc.
- Systems engineering
- Find the silver bullet



Reevaluate the Site Exit Strategy

- Evaluate current environmental and regulatory conditions.
- Update risk assessment assumptions.
- Identify opportunities for increasing program efficiency.
- Update/optimize site closure strategy.
- Develop contingency planning.
- Optimize LTO/LTM - Accelerate to closure.

EXIT

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Identification of Cost Saving Opportunities

- Performance Documentation
- Reported/Recognized Problems and Symptoms
- Principal Program Costs
- Outdated Technologies
- Observed Conditions
- Recognized Alternatives

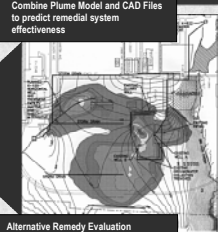
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Remedial Action Optimization

Strategies

- ROD Review
- RBCA
- Predict the effects of changes
- Active vs. Passive
- Reduce time to closure or increase efficiency
- Alternate remedies

Combine Plume Model and CAD Files to predict remedial system effectiveness



Alternative Remedy Evaluation

Soils <ul style="list-style-type: none"> • Intrinsic Bio • Cometabolism • Thermal • Phytoremediation • Electrokinesis • Soil Washing • Ozonation 	Groundwater <ul style="list-style-type: none"> • Natural Attenuation • Air Sparging • Bio Sparging • In-well Aeration • Reductive Dehalogenation • Cometabolic In-situ Bio • Reaction Walls
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Long Term Monitoring Optimization

Objectives:

- Minimize costs, maximize effectiveness/quality
- Efficient compliance and closure
- Eliminate unnecessary and unreliable information

Cost Reduction Strategies:


- Refine DQOs and QA/QC
- Risk/exposure analyses
- Phased closure
- Revise compliance objectives
- Indicator analyses

Innovative Technologies:

- Automated/real time monitoring
- On-site analyses
- Waste minimization/on-site treatment
- Nonintrusive sampling
- Improved well construction

Optimization Procedure:

- Pragmatic justification of sampling location and frequency
- Optimize field procedures
- Optimize analytical protocols
- Streamline/automate/standardize data management and reporting



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Optimization Information Resources

- Federal Remediation Technologies Round table(FRTR) Optimization Homepage
<http://www.frtr.gov/optimization/index.html>
- AFCEE Remedial Process Optimization Homepage
<http://www.afcee.brooks.af.mil/er/rpo.htm>
- Navy RAO/LTM Optimization Web Site
<http://www.enviro.nfesc.navy.mil/erb/support/workgrp/raoltm/main.htm>
- Army Environmental Center Restoration Center
<http://www.aec.army.mil>

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Principal RPO Programs

- USACE - Remedial Systems Evaluation (RSE)
- AFCEE - Long-Term Monitoring Optimization Guide
- AFCEE/ERT - Remedial Process Optimization (RPO), which incorporates:
 - RSE Checklists
 - AFCEE Long-Term Monitoring Optimization Guide
- USAF/ACC - Environmental Restoration Program Site Closure Guidance Manual (SCGM), which incorporates:
 - AFCEE Long-Term Monitoring Optimization Guide
- Dept. of Navy - Saves Money and Alleviates Risk in a Timely manner (S.M.A.R.T)
- NFESC - Guide to Optimal Groundwater Monitoring
- SAIC - SmartSite®

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USACE RSE Optimization Web Site

- <http://www.environmental.usace.army.mil/library/guide/rsechk/rsechk.html>
 - Provides
 - General Instructions
 - Example SOW
 - Example Report
 - All Checklists
 - Contact: Dave Becker, 402-697-2655, dave.j.becker@usace.army.mil

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RSE Summary

- **RSE Goals**
 - Assuring there is a clear system objective (an end to the project),
 - Reducing costs and optimizing the system performance considering current conditions and new technologies,
 - Evaluating the protectiveness of the system in accordance with the National Contingency Plan (the NCP and CERCLA 121(c) requires reviews at least every five years), and
 - Assuring adequate maintenance of government-owned equipment by operators.
- **Levels of RSE Evaluation**
 - The overall site approach and exit strategy
 - The subsurface performance
 - The operation and maintenance of specific components of the remediation system.

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RSE Checklists

- Above Ground Treatment System Performance
- Advanced Oxidation Technologies
- In-Situ Air Sparging Subsurface Performance
- Air Stripping Performance
- Bioventing Subsurface Performance
- Vapor/Off Gas Blower and Piping System
- Landfill Off-Gas Treatment, Thermal Oxidation
- Process Instrumentation and Control
- Environmental Monitoring
- Treatment Water Disposal
- Groundwater Extraction System Subsurface Performance
- Chemical Feed And Storage System

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RSE Checklists (cont.)

- Filtration System Performance
- Remediation System Evaluation Checklist
- Liquid Piping and Pumping Systems
- Liquid Phase Carbon Adsorption
- Metals Precipitation
- Oil Water Separation
- Solids Handling
- Soil Vapor Extraction Subsurface Performance
- Vapor Phase Carbon Absorption
- Extraction, Injection, and Monitoring Wells

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AFCEE Remedial Process Optimization (RPO) Handbook

- RPO Handbook - <http://www.afcee.brooks.af.mil/er/rpo.htm>
- Links to:
 - RPO Outreach Office
 - Long Term Monitoring Optimization Guide
 - Geostatistical Long-Term Monitoring Optimization Algorithm (GTS)
 - Monitoring and Remediation Optimization System (MAROS)

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RPO Objectives

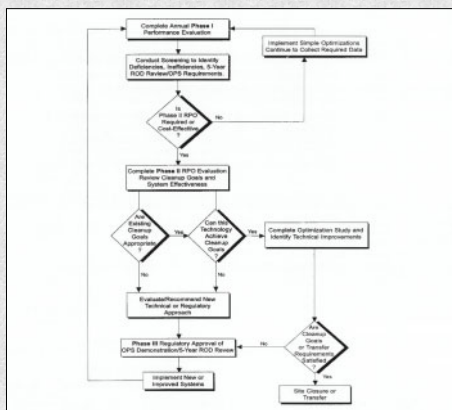
- Ensure Protectiveness
- Reevaluation of Cleanup Goals
- Tracking and Reporting of Remedial Progress
- Reduced Operations and Monitoring Costs
- Accelerate to Closure

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RPO Summary

- Phase I – Annual Review of System Performance
 - Check on cleanup goals
 - Mass removal rates
 - Compliance and Containment
 - General cost analysis
- Phase II - Intensive RPO Evaluation
 - Review of remediation goals
 - Design review
 - Evaluate system operational performance
 - Evaluate system effectiveness
 - Optimization – RSE Checklists and Costing
- Phase III – Implementation of RPO Recommendations

Remedial Process Optimization Sequence



RPO Phase I Report Outline

FIGURE 2.3 EXAMPLE PHASE I LETTER REPORT OUTLINE

- 1.0 Site Overview**
 - 1.1 Remedial Action Objectives
 - 1.2 Remedial System Description
- 2.0 Protectiveness Evaluation**
 - 2.1 Current Protectiveness of Remedy
 - 2.2 Current Regulatory Compliance
- 3.0 System Performance Evaluation**
 - 3.1 SVE Influent VOC Concentration and Flow Rate Trends
 - 3.2 VMP (*In Situ*) Concentration Trends
 - 3.3 Vacuum Influence Overlay
 - 3.4 Mass Removal Estimates
 - 3.5 Progress Toward Cleanup Milestones/Closure Criteria
 - 3.6 Vapor Treatment Effluent vs. Discharge Limits
- 4.0 Cost Evaluation**
 - 4.1 Summary Table of Annual O&M Costs
 - 4.2 Explanation of Cost Increases/Decreases
- 5.0 Recommendations**
 - 5.1 Optimization Activities
 - 5.2 Cost Avoidance Opportunities
 - 5.3 Need for Phase II RPO Evaluation

Attachment – Performance Tracking Tool Data Sheets

RPO Phase II Report Outline

- 1.0 Project Overview**
 - 1.1 Purpose and Scope
 - 1.2 Site History
- 2.0 Review of Conceptual Site Model**
 - 2.1 Current CSM
 - 2.2 Trends in Contaminant Concentrations and Movement
 - 2.3 Natural Attenuation Evaluation
 - 2.4 Exposure Pathways and Receptors
 - 2.5 Refinement of CSM
- 3.0 Evaluation of Cleanup Goals**
 - 3.1 Review of Regulatory Decision Document
 - 3.2 Remedial Action Objectives
 - 3.3 New Regulatory Options
 - 3.4 Evaluation of Risk-Based Goals
 - 3.5 Recommended Revisions to Cleanup Goals
- 4.0 Evaluation of Remedial System**
 - 4.1 Influent Concentration and Flow Trends
 - 4.2 Monitoring Well Concentration Trends
 - 4.3 Equilibrium Test Results
 - 4.4 Treatment System Effluent Trends vs. Discharge Limits
 - 4.5 Performance Criteria/Program Milestones
 - 4.6 Performance To Date
 - 4.7 Demonstration of Effectiveness
 - 4.8 Optimization Opportunities
 - 4.9 New Technology/New Approach Opportunities
- 5.0 Cost Evaluation**
 - 5.1 Summary of Annual O&M Costs
 - 5.2 Cost-Benefit Analysis of Proposed System Changes
- 6.0 Recommendations (as appropriate)**
 - 6.1 Optimization Activities
 - 6.2 New Technology Opportunities
 - 6.3 Revised Cleanup Goals or Approach such as TI Waiver
 - 6.4 New Technical Approach such as Source Isolation/Plume Containment
- 7.0 Implementation Plan (as appropriate)**
 - 7.1 Five-Year ROD Review
 - 7.2 RCRA Permit Reapplication
 - 7.3 O&M Demonstration
 - 7.4 Schedule for Implementation



SAICSmartSite® Systems Engineering Approach

- Technology Enhancement
- Equipment Upgrade
- Process Automation
- Information Management
- O&M Services
- Good Engineering Practices
- Proactive Regulatory Approach
- Performance-based Metrics



- Proactive Managers
- Innovative Engineers
- Empowered Operators

- Operating Systems
- Monitoring Programs



**Optimize Performance
Minimize Costs
Mitigate Risk**



Key SmartSite® Success Features


- Programmatic approach provides logical framework for complex analysis
- Systems engineering analysis evaluates interrelated cost and performance factors
- Integration of emerging and proven technologies yields high value at low cost
- Use of modern IT tools to integrate operations, maintenance, and monitoring data improves and simplifies management
- Fully documented, performance based results support continued improvements



Comparison of Various RPO Strategies

Program Attributes	Inclusion of Attribute in Optimization Program					
	SAIC SmartSite™	ACC SCGM	AFCEE LTMOG	USACE RSE	NFESC GOGM	AFCEE RPO
Strategic Programmatic Approach						
Systems Engineering Approach	X	-	XP	-	-	-
Iterative Evaluation	X	-	XP	-	-	-
Strong SCADA and IT Tools	X	-	-	-	-	-
LTOLTM Component Optimized						
Environmental Systems	X	X	-	X	-	X
Mechanical/Electrical Systems	X	-	-	X	-	X
Operations and Maintenance	X	X	-	X	-	X
Monitoring	X	-	X	X	X	X
Management/Administrative	X	X	-	-	-	-
Detailed Program Guidance						
Data Collection Modules	X	-	-	X	-	-
Life Cycle Financial Analysis	X	X	XP	-	-	X
Support to Related LTOLTM Functions						
QA/QC	X	-	XP	-	XP	X
Ongoing Optimization	X	-	XP	-	XP	X
5 Year Regulatory Reviews	X	X	-	X	XP	X
Closure	X	X	XP	X	XP	X

X = Includes program attribute
 XP = Includes Program attribute for Only Certain LTOLTM components
 ACC SCGM – Air Combat Command, Site Closure Guidance Manual
 AFCEE LTMOG – Air Force Center for Environmental Excellence, Long-Term Monitoring Optimization Guide
 USACE RSE – United States Army Corps of Engineers, Remediation System Evaluation (RSE)
 NFESC GOGM – Naval Facilities Engineering Service Center, Guide to Optimal Groundwater Monitoring

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Summary

- Several concepts of “optimization”
- RPO Optimization Requirements and Programs Are Highly Variable and Technology and Site-Specific
- Optimization can address specific activities, be programmatic, or anywhere in between.
- All optimization requires determination of baseline, evaluation of alternatives, and technical/cost evaluation.
- Multidisciplinary Teams normally required.
- Wide Range in Opportunities for Cost-Saving
- Savings Generally Exceed 20%
- Many challenges to acceptance and implementation